DANVILLE UTILITIES

Standard Policy for the Interconnection of Distributed Resources

Interconnection Agreement

Commission Approved: January 23, 2012

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1.0 Introduction

Customer owned generating equipment may be operated in parallel with the distribution system pursuant to an interconnection agreement, provided that the equipment meets the requirements of this standard.

1.1 Purpose

The purpose of this standard is to set forth the requirements, application procedure, and procedures for connection and safe operation of distributed generation in parallel with the distribution system. There may be costs to the generator owner associated with the interconnection. This standard identifies the nature of those costs.

1.2 Scope

This document sets forth the requirements for interconnection of customer owned, single and three phase distributed generation, up to 500 kW, that operates in parallel with the Danville Utilities' (DU's) distribution system at voltages up to and including 25

kV. This standard describes typical interconnection requirements. Some installations may have additional requirements not noted at this time.

The rules of Federal, state or local regulatory agencies shall take precedence over these requirements.

Requirements for customer owned emergency or standby generators using closed transition automatic transfer switches that parallel with the distribution system for no more than 100 milliseconds **are not** addressed by this document. These are covered by other Company policies.

1.3 Deviation

In the event that requirements for a specific unit or facility are not set out in this document, the Customer may interconnect a facility using requirements authorized by the Director of Power & Light. Deviation from this document may be made only with the consent of the Director of Power & Light or his designee.

If DU concludes that an application for parallel operation describes facilities that may require additional devices and operating schemes, DU shall make those additional requirements known to the Customer before the application can be approved and before interconnection can be made.

1.4 Insurance

Insurance may be required as part of the interconnection contract.

1.5 Safety

The safety of the general public, DU employees, and equipment shall in no way be reduced or impaired as a result of the interconnection. In general, the Customer's facilities will be held to the same standard of care that DU is required to maintain.

2.0 Definitions

Abnormal operating conditions – A situation in which DU is operating the distribution system in other than normal configuration, or under conditions that do not normally exist. Examples of abnormal operating conditions are: (1) high usage days when Customers are requested to conserve energy or, (2) switching feeders out for repairs and switching in alternate feeders.

Application for Distribution Interconnection - The form to be used to apply for approval to connect generation facilities to distribution systems. See attachment, item 15.3.

Customer - Customer, his agent, or partner connected to DU's distribution system for the purpose of receiving electric power through DU's distribution system.

Distributed generation (DG) - Electric generation connected to a utility electric distribution system.

Distributed resources (DR) - Electric generation equipment that may or may not be actual generators, e.g., photovoltaic or other energy generating resources electronically connected to a utility electric distribution system.

Distribution system – DU's wires, equipment, and facilities, with a voltage below 12 kV, to which the generation equipment is interconnected.

DU – Danville Utilities

Facility - An electrical distributed resource installation consisting of one or more on-site distributed resource units.

Interconnection - The physical connection of distributed resource to the distribution system so that parallel operation can occur.

Interconnection agreement – The document that sets forth the contractual conditions under which DU and a Customer agree that a facility may be interconnected with DU's distribution system.

Interconnection equipment - All equipment installed solely to interconnect and exchange power between the Customer's DR facility and DU's distribution system.

Metering, bi-directional - A method of metering that allows the customer to reduce energy usage with energy generated simultaneous with the usage, measuring purchased electric energy and electric energy delivered to DU separately so that purchased energy and energy sold are at different rates. This method allows the customer to sell only the electric energy generated in excess of his usage. See 15.1, Metering Arrangements, Category 2. *Currently not offered by DU at this time.

Metering, independent – A method of metering, that independently measures purchased electric energy and generated electric energy, allowing the total generated electric energy to be sold to DU at a different rate than the purchased electric energy rate. See 15.1, Metering Arrangements, Category 4.

Metering, net – A method of metering that allows for the electric energy delivered to DU at any time during the billing cycle to be subtracted from a customer's purchased electric energy during the same billing cycle, thus compensating the customer for

generated electric energy at the same retail rate that electric energy is purchased. See 15.1, Metering Arrangements, Category 2

Network secondary distribution system – a system of distribution in which the secondary of distribution transformers are connected to a common network for supplying electric power to consumers.

Parallel operation - The operation of electric generation connected to the utility electric distribution system.

Point of interconnection - The point of connection of the customer's service equipment to the utility electric system.

Power delivered – energy supplied by the utility to the customer (generator owner).

Power received – energy supplied by the customer (generator owner) to the utility.

Telemetering- Communications equipment used to obtain information or control the generator, including, but not limited to an RTU, antenna, pole for the antenna, telephone etc.

3.0 System Voltages

DU's distribution systems available for parallel generation operations are grounded wye configuration of various voltage levels up to 25 kV (phase to phase). The voltage level available for connecting the DR to the system depends on the location and the size of the generation.

4.0 Right to Disconnect

DU may disconnect a distributed resource unit from the distribution system for any of the following conditions:

1. Expiration, termination, or lack of interconnection agreement.
2. Non-compliance with the technical requirements.
3. System emergency.
4. Situations when continued interconnection will endanger persons or property.
5. Routine or emergency maintenance, repairs, or modifications to the distribution system.
6. Violation of environmental laws or regulations.

7. Decrease in the quality or reliability of electric service to other customers due to Customer equipment.
8. Hazardous conditions.

5.0 Pre-Interconnection Studies.

Pre-interconnection study - A study by DU of a proposed interconnection with the utility distribution system. Pre-interconnection studies may include, but are not limited to:

(a) **Site visit** – A review to determine the system voltage and interconnection requirements at the proposed site of the distributed resource (DR).

(b) **Coordination study**- An engineering analysis that determines whether the presence of the DR unit at a particular location would interfere with the protective fusing and relaying on the distribution system. It includes a review of the fault current contribution by the DR unit and the effects on the DU distribution system.

(c) **Distribution system study** – An engineering analysis that models the distribution system with the proposed DR in place to determine whether the feeder will support the DR unit without reliability problems or interruptions in service to other customers. The analysis includes a review of the DR contribution to power flow and the effects on the distribution system voltage.

(d) **Network study** – An engineering analysis to determine whether a distributed resource facility can be added to a network secondary distribution system.

DU may, at the Customer's expense, conduct pre-interconnection studies prior to interconnection of a distributed resource facility. Inverter and other types of generators, that are single phase and smaller than 10 kW, or three phase, smaller than 75 kW, and are listed to UL 1741, Rev.2, will not require studies.

Aspects of network secondary distribution systems are unique and present technical difficulties to interconnection. In all cases DU will conduct pre-interconnection studies to determine if distributed resources may be connected to the network secondary distribution system as defined in section 2.0.

6.0 Generators Permitted

Single and three-phase alternating current generating units, including synchronous, induction, and various inverter controlled systems, can be operated in parallel with the distribution system. The total connected capacity shall not exceed 500 kW.

6.1 Limits on Three Phase Generators

If three-phase service is not available in the area, or if DU facilities must be upgraded to enable the Customer to interconnect, the Customer may incur additional cost for such service or improvements as determined by DU. DU reserves the right to refuse three-phase service.

6.2 Limits on Single Phase Generators

Where necessary, to avoid the potential for a DR facility to cause problems with the service of other Customers, DU may limit the capacity and operating characteristics of single-phase generators in a manner consistent with its existing limitations for single-phase motors. Ordinarily, single-phase generators shall be limited to a capacity of 10 kW or less.

7.0 General Interconnection Requirements

The Customer's distributed resource facilities shall meet the technical requirements as prescribed in this section and Danville Utilities RIDER "N", Net Metering Service agreement. DU reserves the right to impose additional requirements as necessary.

7.1 Customer's Equipment and Interconnection Standards

The Customer's generation and interconnection installation must meet all applicable federal, state, and local construction and safety codes.

The Customer shall be responsible for the design, installation, operation and maintenance of all equipment and facilities installed or that will be installed on the Customer's side of the point of interconnection. Such design shall meet the latest standards of IEEE, NEMA, ANSI, NEC, other national codes and any local codes pertaining to the design and construction of electrical facilities. The facility shall be subject to the requirements of all authorities having jurisdiction and shall comply with all applicable codes and ordinances.

7.2 Protection of Customer's Equipment

The Customer will be responsible for protecting its equipment in such a manner that distribution system outages, short circuits, or other disturbances do not damage the Customer's equipment.

7.3 Drawings

Adequate drawings of the Customer's proposed DR facility, which include a one line diagram and diagrams of the relay system, may be required for review. Additional drawings may also be required.

7.4 Changes Danville Utilities Facilities

The Customer may be responsible for the cost of additional equipment that must be installed by DU on its distribution system to allow parallel operation.

7.5 Power Factor

The power factor at the point of interconnection shall be according to the rate schedule for the installation.

7.6 Voltage Regulation

Unless otherwise specified by the Danville Utility Commission (DUC) or other applicable regulatory authority, the Customer will operate his generating equipment within the ranges specified by ANSI C84.1 Table 1, Range A, measured at the point of interconnection. On a 120 volt basis, this range is 114-126 volts.

7.7 Interrupting For Faults

The Customer's equipment shall automatically disconnect the generation from the distribution system, within the times shown, if the voltage falls within those shown in Table 1 below. (IEEE 1547, Para. 4.2.3, Table 1)

Table 1

Response to Abnormal Voltages Under Fault Conditions	
Percent of Normal Voltage	**Clearing Time in Seconds**
Below 50	0.16
50 to 88	2.0
110 to 120	1.0
120 and above	0.16

In the event the Customer's generator fails to disconnect, creating a hazardous condition on DU's system, the customer shall be liable for resulting damage and injuries.

Unless otherwise agreed to, reconnection shall be permitted 5 minutes after the utility voltage returns to normal range, as defined by ANSI C84.1 Table 1, Range B.

7.8 Voltage Flicker

The generation shall not create objectionable voltage flicker for other customers, as determined by DU. Failure to meet these limits may result in immediate disconnection by DU until corrected.

7.9 Frequency

When the system frequency is in a range shown in Table 2, the Customer's generating equipment shall automatically disconnect from the distribution system as indicated. Where adjustable clearing times are shown, the settings will be coordinated with DU. (IEEE 1547, Para. 4.2.4, Table 2)

Table 2

Response to Abnormal Frequency Conditions		
Generator Size	**Frequency Range (Hz)**	**Clearing Time in Seconds**
30 kW and smaller	Below 59.3	0.16
	Above 60.5	0.16
Larger than 30 kW	Below 57.0	0.16
	57.0-59.8	Adjustable 0.16 to 300
	Above 60.5	0.16

Unless otherwise agreed to, reconnection shall be permitted 5 minutes after the utility frequency returns to normal range, 59.3 to 60.5 Hz.

7.10 Harmonics

The Customer must comply with IEEE 519-1992.

7.11 Unintentional Islanding

For an unintentional island in which the DR energizes a portion of the DU distribution system through the interconnection, the DR interconnection system shall detect the island and cease to energize the DU distribution system within two (2) seconds of the formation of an island. (IEEE 1547, Para. 4.4.1).

8.0 Transformer Connections

Six interconnection transformer configurations are used to interconnect DR with the utility system; each has inherent advantages and disadvantages. Regardless of which party owns the interconnection transformer, it is important that the impacts to the distribution system be considered. The interconnection transformer connection can adversely affect the utility feeder protection scheme, and can have adverse effects on the lightning arresters on the feeder. When the transformer is customer owned, it is important that the connection type be provided to DU so that the impacts to the utility electric system can be considered. Additionally, the use of neutral resistors at the transformer, generator, or both, has impacts that must be considered. Certain configurations may not be acceptable depending on the effect it has to the distribution

system, while others may require modifications to the distribution system. Table 3 shows six configurations, noting problems and advantages of each type.

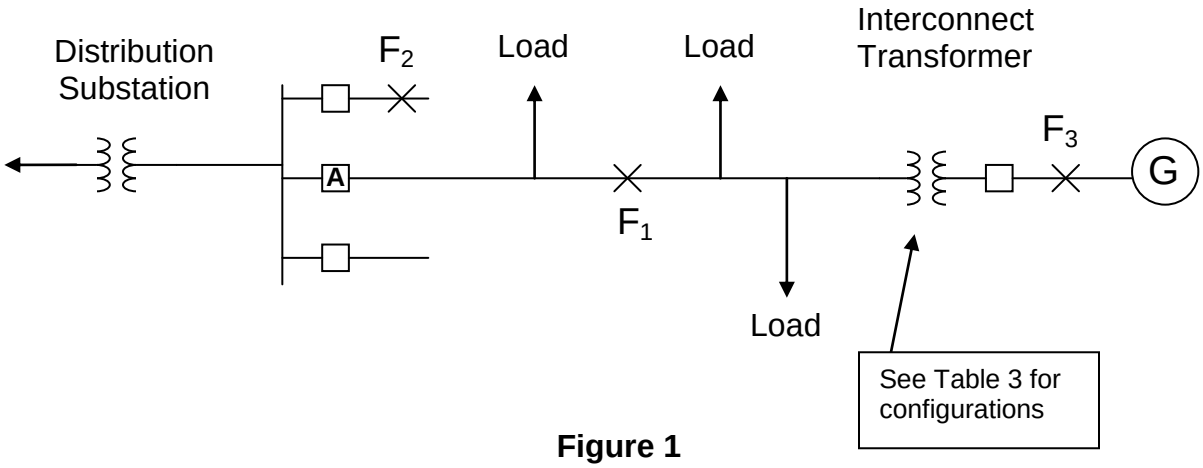
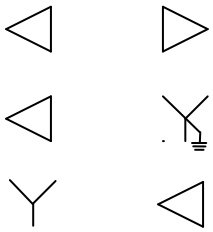
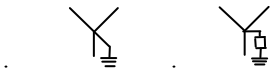


Figure 1

Table 3

Interconnect Transformer Connections **High Voltage Low Voltage**	**Problems**	**Advantages**
	Can supply the feeder circuit from an ungrounded source after substation breaker **A** trips causing overvoltage.	Provides no ground fault backfeed for fault at F_1 & F_2. No ground current from breaker **A** for a fault at F_3.
	Provides an unwanted ground current for supply circuit faults at F_1 and F_2, and reduces ground current at breaker **A** for restricted faults at F_1	No ground current from Breaker **A** for faults at F_3. No overvoltage for ground fault at F_1.
	Allows source feeder relaying at **A** to respond to a secondary ground fault at F_3.	No overvoltage for ground fault at F_1.
 Resistance grounded neutral	Can supply the feeder circuit from a resistance grounded source, after substation breaker **A** trips, causing overvoltage.	Provides reduced ground fault backfeed for fault at F_1 & F_2. Reduced ground current from breaker **A** for a fault at F_3.

9.0 Inspection and Tests

DU reserves the right to inspect and/or observe the testing, of any of the Customer's protective equipment that is essential to the interconnection, including relays, circuit breakers, protective devices and related equipment, but has no responsibility either actual or implied to do so. Inspection may include simulated test tripping of the Customer's interconnection breakers by the protective relays to verify all protective set points and relay/breaker trip timing prior to connection to the DU system. Unless waived, this inspection and testing shall be performed prior to interconnected operation of the generator.

The Customer shall provide DU with notice at least two weeks before the initial energizing and start-up testing of the Customer's generating equipment so that DU may witness the testing of any equipment and protective systems associated with the interconnection.

DU reserves the right to perform additional inspections or tests of the Customer's protective equipment any time a system emergency develops, safety issues arise, or the quality of service to other Customers deteriorates, as deemed necessary by DU.

10.0 Customer Responsibilities

10.1 Operations

The customer is solely responsible for proper operation of the customer's generation facilities.

10.2 Maintenance

The Customer shall be required to maintain records of maintenance activities, which DU may review at reasonable times. Maintenance records should be made available for DU's inspection upon request. DU reserves the right to inspect the records, but has no responsibilities for maintenance either actual or implied.

10.3 Load Shed

If the generator drops off line, an automatic load shed scheme may be required to shed the Customer's load should this additional load exceed the available capacity of or cause excessive voltage sag on the distribution circuit. Such requirements shall be noted in the contract.

11.0 Protection Requirements

11.1 Changes DU Fault Interruption Equipment

A customer generator on the distribution system is an additional source of fault current. The Customer may be required to limit the fault current. Should DU be required to make changes due to the additional fault contribution, the Customer shall have to pay the cost of the required changes.

11.2 Protection Equipment

The necessary protective equipment shall be established in the design phase and confirmed prior to start-up of the Customer's generation facilities. DU has the right to require certain protective devices, including relays that the Customer must install. Settings of interconnection protective devices on the Customer's system will be specified by the Customer, but will be reviewed by DU. DU may request changes to the Customer's relay settings.

11.3 Disconnect Switch

The Customer's generation facilities shall have a visible break, lockable, manually operated disconnect switch, at the service entrance, in a location accessible to DU personnel. DU reserves the right to open the disconnect switch without prior notice for any of the reasons noted in item 4.0. At DU's discretion, the revenue meter may serve as the disconnect switch, for use only by DU personnel.

11.4 Energizing Dead Circuits

The Customer shall not energize a de-energized DU distribution circuit.

11.5 Protection from Automatic Reclosing

DU normally applies automatic reclosing after fault clearing on all overhead distribution lines. The duration of outages due to clearing temporary faults is most frequently in the range of 0.1 - 2.0 seconds, but varies depending on many factors. The automatic reclosing schemes often assume that the circuit is dead and do not employ any voltage check, phasing, or synchronization schemes. The customer must insure that his generation is disconnected from the distribution system prior to automatic reclosing. DU will assume no responsibility for damage to the customer's equipment due to out–of–phase reclosing.

It is possible to install voltage check schemes at some locations on DU system to prevent automatic reclosing. At the discretion of DU, these voltage check schemes may be installed at the customer's expense. When these schemes are contemplated, both the preferred and the alternate circuits that can supply power should be considered.

11.6 Synchronous Generators

Overcurrent devices (circuit breakers) for synchronous generators shall be three-phase devices with electronic or electro-mechanical control. The Customer is solely responsible for properly synchronizing the generator with the distribution system.

11.7 Induction Generators and Inverter Systems

Induction generation may be connected and brought up to synchronous speed as induction motors if it can be demonstrated that the initial voltage drop measured on the distribution system at the point of interconnection is within the limits stated above. The Customer may be required to install equipment or employ other techniques to bring voltage fluctuations to acceptable levels.

Self-commutated inverters, whether of the utility-interactive type or stand-alone type, shall be used in parallel with the distribution delivery system only with synchronizing equipment. Line-commutated inverters do not require synchronizing equipment.

11.8 Requirements for Units 10 kW or Less

These Facilities shall have:

a. Accessible, lockable, visible break disconnect switch at the service entrance.

b. Over-current protection.

c. Over/under voltage trip.

d. Over/under frequency trip.

e. Manual or automatic synchronizing (may omit if not capable of stand alone operation).

Note: Inverter based units must meet the non-islanding requirements of UL 1741 Rev. 2.

11.9 Requirements for Units 11 kW to 500 kW.

These facilities shall have:

a. Accessible, lockable, visible break disconnect switch at the service entrance.

b. Over-current protection.

c. Over/under voltage trip.

d. Over/under frequency trip.

e. Manual or automatic synchronizing (may omit if not capable of stand alone operation).

f. Ground fault detection and tripping.

g. Reverse power tripping, if not exporting.

Note: Inverter based units that meet the non-islanding requirements of UL 1741, Rev. 2.

12.0 Metering Requirements

Section 15.1 outlines four metering arrangements utilized by DU.

Telemetering may be required depending on the output or the application of the Customer's generating facility. Generally, generators smaller than 500 kW will not require telemetering. The customer may be required to reimburse DU for telemetering.

13.0 Modifications to DU or Customer Facilities

13.1 DU Changes to Distribution System

The distribution system is a dynamic and changing system. DU reserves the right to make changes from time to time. The Customer may be responsible for paying for some or all modifications required for reconnecting to DU's reconfigured distribution system.

13.2 Customer Changes to Interconnection

The Customer shall notify DU to obtain prior approval for any proposed modifications to the interconnecting scheme.

14.0 References

IEEE Std. C37.95, Guide for Protective Relaying of Utility-Consumer Interconnection (Latest revision)

IEEE Std. 519-1992, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems,

IEEE Std. 141-1993 Recommended Practice for Electric Power Distribution for Industrial Plants,

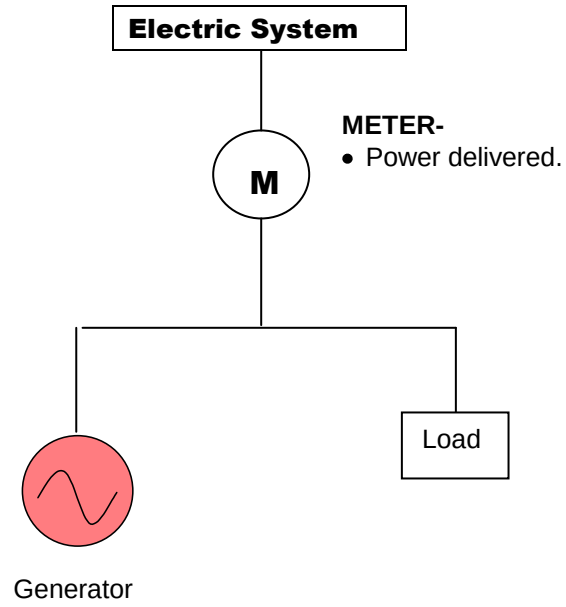
UL 1741, Rev. 2 Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems

IEEE Std. 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

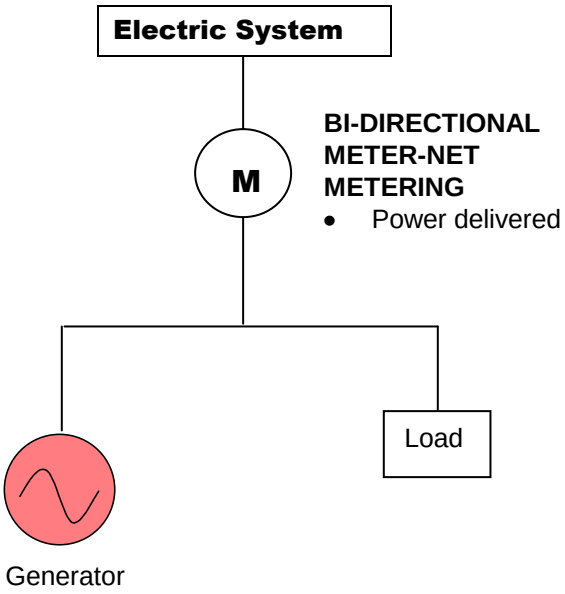
15.0 Attachments

15.1 Metering Arrangements

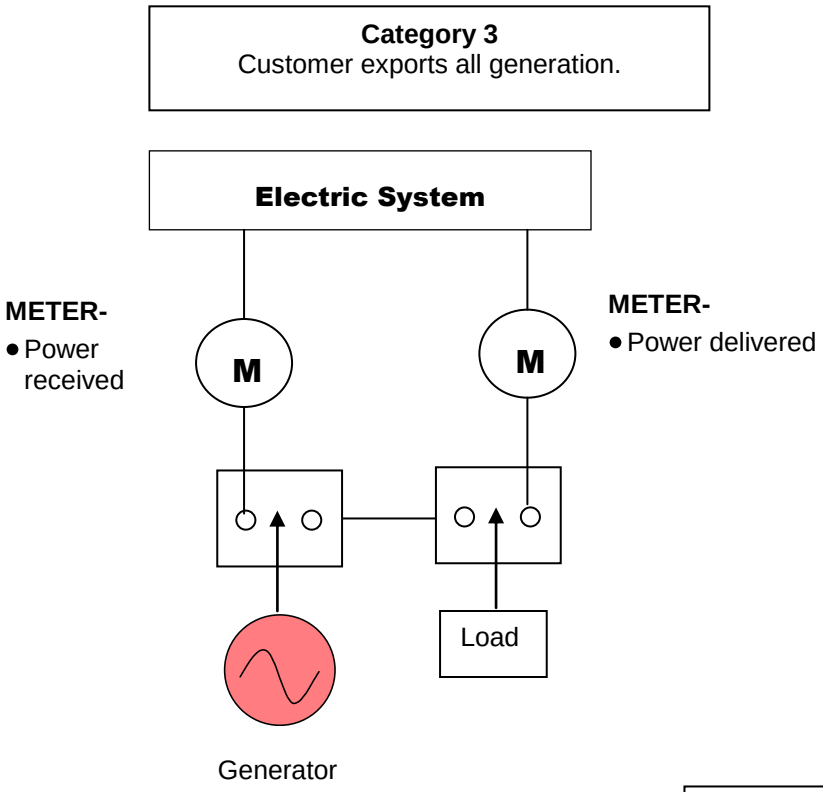
Category 1
Customer does not export power.

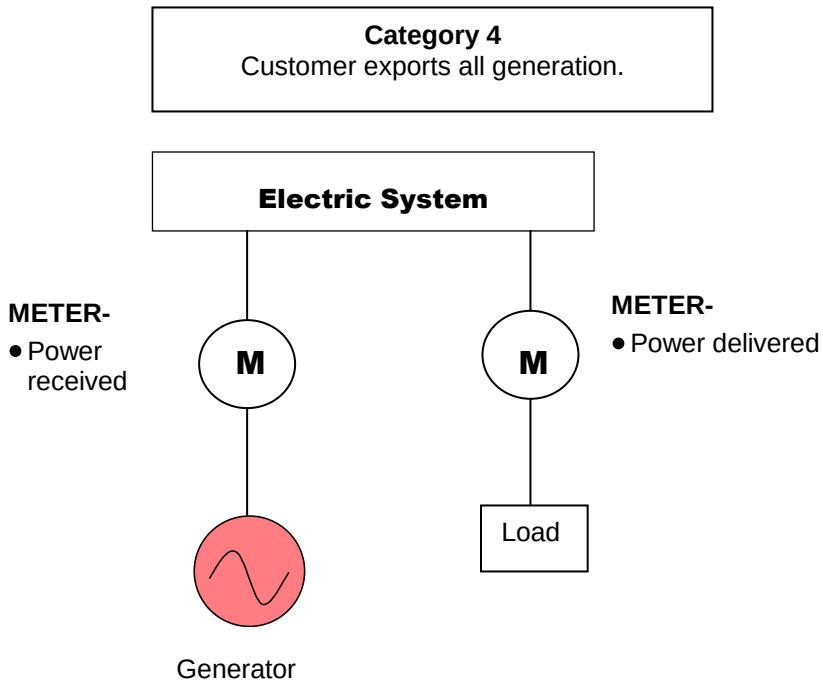


Category 2
Customer may export.



15.1 Metering Arrangements (Continued)





15.2 Customer DR Technical Requirements Checklist

This is a summary of the requirements.

Requirement	Comments
a. Accessible, lockable, visible break disconnect switch at the service entrance.	
b. Overcurrent protection.	
c. Over/Under voltage tripping.	
d. Over/under frequency tripping.	
e. Manual or auto synchronizing.	
f. Ground fault detection.	
g. Reverse power tripping, if not exporting.	
h. Automatic voltage regulation.	

15.3 Interconnection Notification

PURSUANT TO RULE 20 VAC 5-315-30 OF THE COMMISSION'S REGULATIONS GOVERNING NET ENERGY METERING, APPLICANT HEREBY GIVES NOTICE OF INTENT TO OPERATE A GENERATING FACILITY.

Customer Name: _____

Service Address: _____

City: _____ State: _____ Zip Code _____

Phone Number(s): _____ Cell: _____

Email Address: _____

Facility Location (if different from above):_____

Distribution Utility Account Number: _____

Proposed Interconnection Date: _____

Request for Purchase Power Agreement in accordance with RULE 20 VAC 5-315-50 (circle one): Yes No

Section 2: Generating Facility Information

Facility Owner and/or Operator Name (if different from Applicant):_____

Business Relationship to Applicant: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Street Address: _____

City: _____ State: _____ Zip Code: _____

Phone Number: _____ Email Address: _____

Fuel Type: _____

Generator Manufacturer and Model: _____
Rated Capacity in Kilowatts: AC: _____ DC: _____

Inverter Manufacturer and Model: _____

Battery Backup (circle one): Yes No

Section 3: Information for Generators with an AC Capacity in Excess of 25 kilowatts

Generator Type (circle one): Inverter Induction Synchronous

Frequency: _____ Hz; Number of phases (circle one): One Three

Rated Capacity: DC _____Kw; AC apparent_____KVA; AC real_____Kw;

Power Factor_____%; AC voltage_____ AC amperage _____

- Facility schematic and equipment layout must be attached to this form.

A prospective Net Metering Customer considering installing a renewable fuel generator with a capacity in excess of 25 Kw is strongly encouraged to contact Danville Utilities prior to making any financial commitments to the project.

Section 4: Vendor Certification:

The system hardware is listed by Underwriters Laboratories to be in compliance with UL 1741.

Signed (Vendor): _____ Date: _____

Name (printed): _____

Company: _____

Phone Number: _____ Cell: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Section 5: Electrician Certification:

The system has been installed in accordance with the manufacturer's specifications as well as all applicable provisions of the National Electrical Safety Code.

Signed (Licensed Electrician): _____ Date: _____
Name (printed): _____

License Number: _____ Phone Number: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Utility signature signifies only receipt of this form, in compliance with the Commissions net energy metering regulations, Regulation 20 VAC 5-315-30.

Signed (Utility Representative): _____ Date: _____

I hereby certify that to the best of my knowledge, all of the information provided in this notice is true and correct.

Signature of Applicant: _____**Date:** _____